Migraine - selected aspects of pathophysiology and diagnostics

(Migrena – wybrane aspekty patofizjologii i diagnostyki)

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Abstract – Introduction. Headache is caused by stimulation of peripheral nociceptive devices. This stimulation can be induced by various factors. In the case of primary pain, it should first be determined whether the pain is caused by migraine. You can use the knowledge of the typical symptoms accompanying migraine.
The aim of the study. The aim of this study was to present the characteristics of migraine pain and differential diagnostics.
Selection of material. The search was conducted in the Scopus database using the terms migraine, pathophysiology, diagnostics 2005-2018. The literature found in the Google Scholar database was analysed for the highest number of citations. The literature selected in this way was used as a material for the preparation of this paper.
Conclusions. Headaches usually require specialist help. The treatment offered must be safe and effective. Particularly important in the case of headaches is the consideration of contraindications to therapy and appropriate communication with the patient during therapy. Warning symptoms must be taken into account in the entire interpretation of the disease.

Key words – migraine, pathophysiology, differential diagnosis.

Streszczenie – Wprowadzenie. Ból głowy wywołany jest poprzez pobudzanie nocyceptorów obwodowych. Pobudzenie to może być indukowane różnymi czynnikami. W przypadku bólu o charakterze pierwotnym należy przede wszystkim ustalić czy ból nie zostały wywołany migreną. Można się przy tym posłużyć wiedzą o typowych objawach towarzyszących migrenie.
Cel badań. Celem pracy było przedstawienie charakterystyki bólów migrenowych oraz diagnostyki różnicowej.
Dobór materiału. Poszukiwania przeprowadzono w bazie Scopus używając pojęć *migrena, patofizjologia, diagnostyka* 2005-2018r. Znalezione piśmiennictwo w bazie Google Scholar przeanalizowano pod kątem największej liczby cytowań. Tak wyselekcjonowane piśmiennictwo posłużyło za materiał do opracowania niniejszej pracy.
Wnioski. Bóle głowy wymagają z reguły pomocy specjalistycznej. Oferowane leczenie musi być bezpieczne i skuteczne. Szczególnie ważne w przypadku bólów głowy jest uwzględnienie przeciwwskazań do terapii oraz odpowiednia komunikacja z pacjentem w trakcie terapii. W całości interpretacji obrazu chorobowego należy uwzględnić objawy ostrzegawcze.

Słowa kluczowe – migrena, patofizjologia, diagnostyka różnicowa.

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A. The idea and the planning of the study
B. Gathering and listing data
C. The data analysis and interpretation
D. Writing the article
E. Critical review of the article
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I. PATHOPHYSIOLOGY

Headache is caused by stimulation of peripheral nociceptive receptors and the factors that may cause it are tissue trauma, visceral dilatation and other factors such as damage to the peripheral or central nervous system (CNS). Headache may occur in the following parts of the head:

central meningeal artery, sinuses of the dura mater, scalp, sinuses of the dura mater, sickle of the brain, sections of large soft tyre arteries in the proximal direction. The phenomenon of primary headache is associated with the following tissues and organ parts [1,2]:

- large vessels in the intracranial zone and in the dura mater,
- the endings of the trigeminal nerve, which innervate the individual structures,
- the caudal part of the trigeminal nerve - it is located in the dorsal corners and in the cervical part of the spinal cord,
- systems responsible for modelling pain in the brain - they receive stimuli from the trigeminal nerve.

In the case of primary pain, it should first be determined whether the pain was not caused by migraine. The knowledge about typical symptoms accompanying migraine can be used.[3-5] The raaskin indicates that the most common migraine symptoms are [6]:

- feeling of nausea - 87% of cases,
- hypersensitivity to light - occurs in 82% of patients,
- Frequent dizziness and feeling of uncertain movements - 72% of patients,
- skin tenderness on the head - 65/5 cases,
- 56% vomiting,
- visual impairment - 36%,
- paresthesias - 33%,
- dizziness or feeling of spinning - 33%.

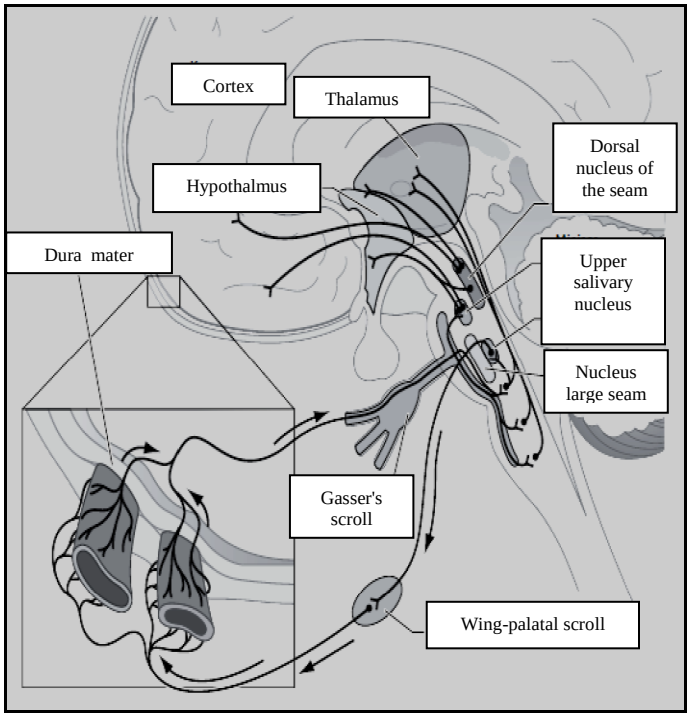


Figure 1. Migraine headache pattern [1,2,7]

The main pain pathway in migraine is the inflow of stimuli through the trigeminal nerve from the meningeal vasculature, passing through the trigeminal ganglia and switching on the synapsis on second-order neurons in the trigeminal-neural complex. These neurons in turn give projections to the trigeminal-thalamic pathway and after crossing within the brainstem switch synaptically to the thalamic neurons. The sources of important modulation coming from the trigeminal nerve and nociceptive stimulus vessels are: the dorsal nucleus of the suture, the bluish place and the great nucleus of the suture. More and more data speak for the role of dopamine in the pathophysiology of certain migraine subtypes. By dopamine stimulation most of the symptoms of migraine can be caused. In addition, there is a dopamine receptor hypersensitivity in migraine patients. [1,2,6,7]

II. DIAGNOSTICS

The table presents the criteria used according to ICHD-2 procedures for recognition of migraine without aura and migraine aura.

Table 1. Criteria for diagnosis of migraine without aura and migraine aura according to ICHD -2 [8]

Migraine without migraine aura	Migraine Aura
A. Presence of at least 5 phenomena that meet the criteria of points B to D B. The paroxysmal headaches last from 4-72 hours (if untreated). C. For headache, at least 2 of the following characteristics may be indicated: ○ it appears on one side of the head, ○ creates the impression of pulsating pain, ○ is moderate or significant, ○ the intensity of pain increases during normal physical activity, D. During pain attacks at least one of the following phenomena also occurs: ○ feelings of nausea or vomiting, ○ hypersensitivity to light and sound E. Furthermore, headache is not related to other health disorders	A. Presence of at least 2 phenomena that meet the criteria of points B to D B. The aura shall be free from paresis and at least 1 of the following symptoms shall be observed: ○ a completely reversible vision impairment of an excess of vision such as, for example, spot vision, flicker or cavity vision, (visual impairment) ○ COMPLETELY reversible sensory disturbances of an excess (e.g. tingling) or cavity character (numbness), ○ totally reversible speech disorders C. The presence of at least two of the following characteristics: ○ a visual impairment of one-sided nature or a unilateral sensory impairment, ○ at least one of the aura symptoms develops gradually over a period of at least 5 minutes and the various aura symptoms follow each other over a period of at least 5 minutes, ○ each aura takes more than 5 minutes and less than 60 minutes, D. The headache typical of migraine without aura begins within 60 minutes after it recedes. E. The aura symptoms are not associated with other types of disorders.

Using the above criteria, it is very likely that the patient will be diagnosed with migraine. The following table presents ICHD-2 criteria for the diagnosis of episodic tension-type headache.

Table 2. ICHD-2 criteria for the diagnosis of episodic tension-type headache [8]

Tension type pain is rare	Chronically present tension-type pain
A. There shall be at least 10 episodes less than 1 day per month which meet the following criteria according to B-D: B. The pain lasts from 30 minutes to 7 days. C. Headache includes at least 2 of the following characteristics: o it shall appear on both sides, o causes a feeling of squeezing of the head (not pulsation), o its severity is moderate or minor, o does not increase due to normal physical activity, D. The following additional characteristic factors are present in terms of pain: o there is no nausea or vomiting, but there may be aversion to eating, o there's no hypersensitivity to sound, or to a small extent, E. The headache is not associated with other disorders.	A. The pain shall be revealed on average at least 15 days per month for more than 3 months (more than 180 days per year) and criteria B-D shall be met. B. The headache persists for several hours and is continuous. C. The pain has at least two of the following characteristics: o it occurs on both sides of the head, o is compressive or compressive, o is present in a moderate to minor degree, o does not increase with normal physical activity D. In addition, the following conditions are met: o no hypersensitivity to light, to sound, slight nausea may occur, o no moderate or severe nausea or vomiting, E. Headache is not attributed to other disorders

Additionally, there is also a frequent, episodic tension headache. In the case of this pain, at least 10 episodes are considered to be the diagnostic criterion as for rare tension-type headache. These episodes must take place more often than 1 day per month, but less frequently than 15 days per month, for at least 3 months. [1,2,7,8].

Figure 2 shows the procedure for diagnosing a case with likely spontaneous heaache.

The first step in the diagnosis of pain of a presumed spontaneous nature is to determine the incidence of pain (criterion 15 days per month).

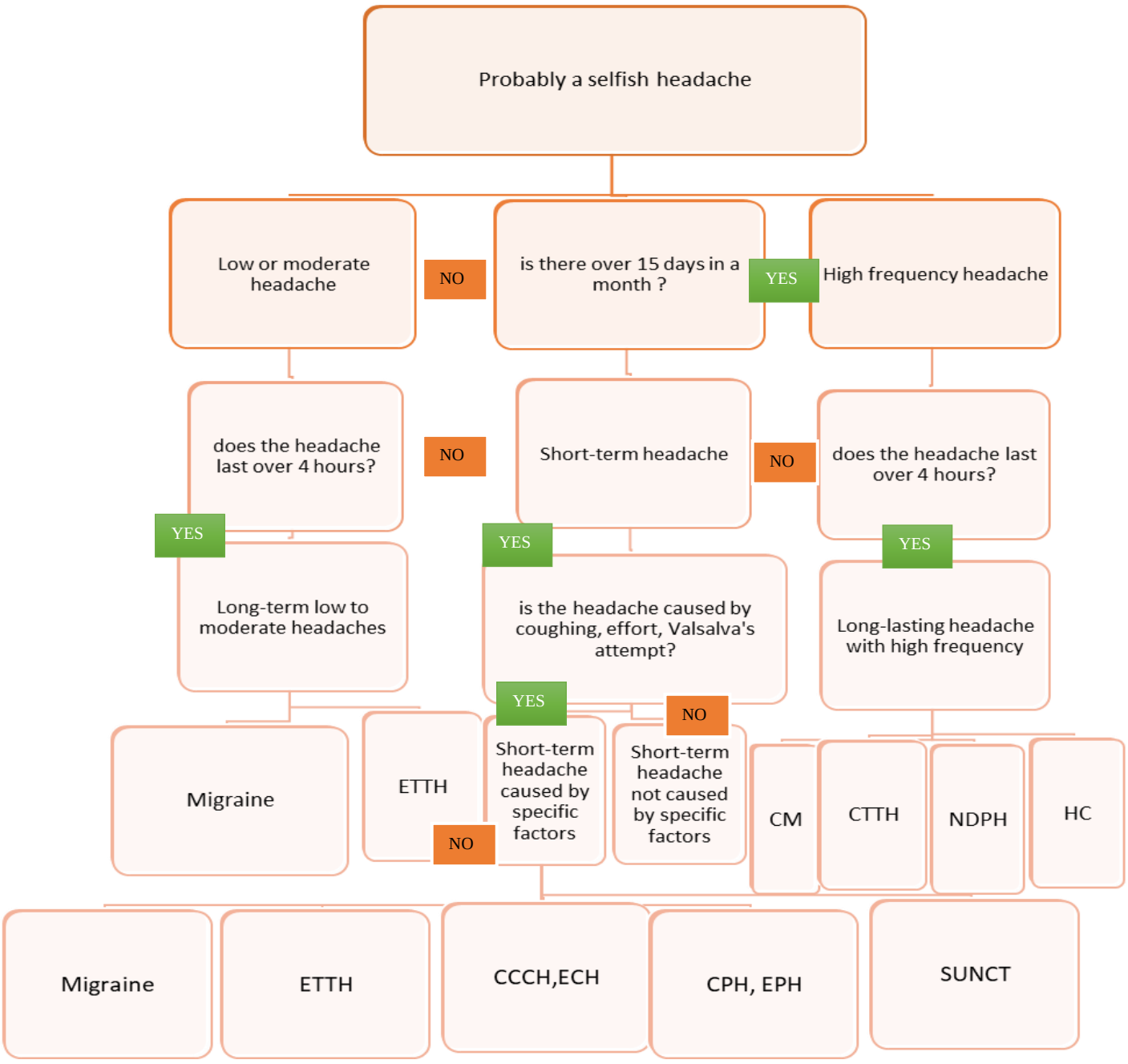
It is then determined whether the pain lasts for at least 4 hours. The result of the diagnosis is that a specific case is included in one of four states of pain [1,9,10]:

- long lasting pain of low or moderate frequency,
- a short-term headache caused by certain factors,
- a short-term headache not caused by specific factors,
- long lasting high frequency headache.

Other types of spontaneous headaches than migraine and tension-type pain include [1,4,8]:

- spontaneous stabbing-like headache - these are episodic, localized seizures of stabbing-like headache occurring spontaneously in the absence of any structural cause, lasting no longer than several seconds and recurring at irregular intervals from one to many seizures per day, without other symptoms, e.g. vegetative disorders,
- spontaneous coughing headache - the factors that cause headache are coughing, tensioning of the abdominal compressor when passing stool or Valsalva's test, but not other stimuli, there is no other disease that could cause such pain, e.g. brain aneurysm, especially Arnold and Chiari's malformation,
- spontaneous headache, physical effort is the only factor causing headache, the pain is pulsating and lasts from 5 minutes to 48 hours, after the first episode of sudden pain caused by physical effort appropriate diagnostic tests should be carried out to exclude subarachnoid hemorrhage and delamination of the artery,
- spontaneous headache associated with sexual activity, usually starts as a bilateral blunt headache as the sexual arousal increases and suddenly increases in strength during orgasm,
- intermediate headache - occurring in older people and characterized by short (usually lasting 30 minutes) seizures of night-time headache, which wakes the patient up at a fixed night time, does not occur outside the sleep period,
- spontaneous, lightening headache - a severe headache with a sudden onset, mimicking the pain caused by a ruptured aneurysm,
- continuous half-hearted headache - strictly unilateral headache is characterized by invariably favourable response to therapeutic doses of indomethacin, the severity of pain is moderate, periodically increasing to high, increased intensity of pain is accompanied by vegetative disorders,
- new persistent daily headache - the features of this pain, which in other respects resembles chronic tension-type headache, are the daily occurrence and persistence of symptoms observed from the very beginning of the disease or shortly after its appearance (<3 days).

The spontaneous pain, although troublesome for the patient and lowering his or her quality of life, is rarely life-threatening. It is much more important to recognize sudden pains that have secondary origin as these may result from dangerous health conditions.



ETTH = episodic tension-type headache, CCH = chronic cluster headache, ECH = episodic cluster headache, CPH = chronic paroxysmal hemiplegia, EPH = episodic paroxysmal half-headache; SUNCT = short-term unilateral attacks of neuralgia-like headache with conjunctival hyperemia and tearing CM = przewlekła migrena; CTTH = chronic tension type headache; NDPH = new daily persistent headache, HC = half headache continuous

Figure 2 . Procedure for diagnosing spontaneous pain in a patient [1,2,8]

III. EVERY HEADACHE REQUIRES AN ACCURATE DIAGNOSIS

The general diagnostic procedure for headache is presented in Figure 3.

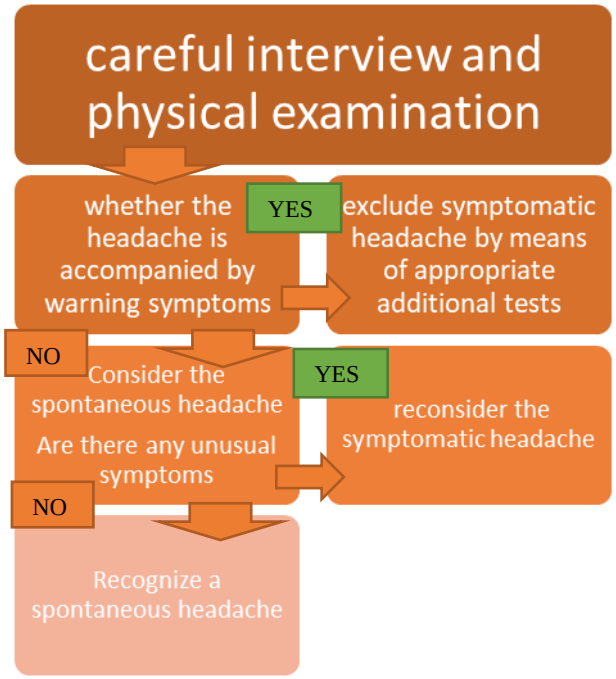


Figure 3. Procedure for the diagnosis of headache [6,11-13]

A thorough history and physical examination of the patient is important; the paramedic should focus on the fact that [11-13]:

- is the current pain, which seems to be the strongest in life?
- is such severe headache very rare ?
- does the intensity of headache occur for several days or weeks ?
- did the neurological examination reveal any abnormalities ?
- is there a fever or other systemic symptoms of inflammation ?
- is vomiting present ?
- does the headache get worse when bending over, coughing or lifting a load?
- does the pain interfere with sleep or occur just after waking up?
- can the pain be caused by chronic illness ?
- has the headache occurred or is it getting worse after the age of 55?
- does the pain occur in combination with spontaneous and/or compression pain in a particular area of the body ?

In many cases, neuroimaging examinations are necessary, most often of the head and cervical section of the spine.
Headaches usually require specialist help. The treatment offered must be safe and effective. Particularly important in the case of headaches is the consideration of contraindications to therapy and appropriate communication with the patient during the therapy. Warning symptoms must be taken into account in the entire interpretation of the disease. [11-14]
The table shows various warning symptoms that may indicate various types of headaches, especially those of the non-self-reliant.

Table 3. Warning symptoms of various types of headache [6,11-14]

Warning symptom	Possible cause of pain
headache with a sudden start	subarachnoid hemorrhage, bleeding into or from an arterio-venous malformation, brain tumour (especially in the posterior cranial cavity)
ever-increasing headache	brain tumor, subdural hematoma, drug misuse
headache accompanying systemic symptoms (fever, neck stiffness)	meningitis, encephalitis, neuroborreliosis, systemic infection, connective tissue disease, vasculitis
focal neurological or other symptoms other than typical visual or sensory aura	brain tumour, arterio-venous malformation, connective tissue disease with vascular involvement
oedema of the optic nerve discs	brain tumour, pseudo brain tumour, encephalitis, meningitis
headache caused by a cough, effort or attempted Valsalva	subarachnoid hemorrhage, brain tumor
headache during or after pregnancy	cerebral cortex vein thrombosis/seizure, delamination of the carotid artery, pituitary hemorrhage
a new type of headache in patients with: cancer, borreliosis, AIDS	metastasis, meningitis, opportunistic infection, brain tumour

The presented text shows that warning symptoms of headache may be caused by various diseases and often dangerous diseases.

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